# Attitude and Orbit Navigation Scanner for sub-Nanosat Scale Platforms

Completed Technology Project (2013 - 2015)

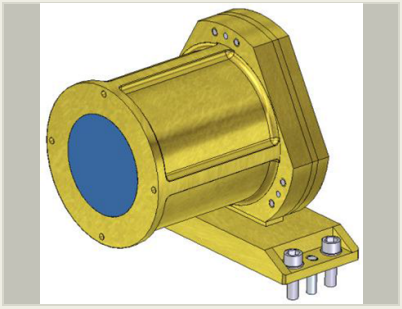
## Project Introduction

This research targets a miniature star scanner (SS Nano) to replace star trackers that cannot meet the Size, Weight, and Power (SWaP) requirements of small nanosat spinners that need sub-arcminute attitude knowledge. The proposed Guidance, Navigation, and Control component development will include compact frontend optics, a high resolution detector, signal conditioning, and pattern matching and attitude determination algorithms for either onboard or ground processing. SS Nano will launch on a sounding rocket in February 2015.

A compact attitude and orbit determination system for small nanostats, particularly for smaller than a 1U cube, is not currently available. Conventional trackers and GPS receivers may not be feasible for platforms less than 1 kg because of prohibitively large components that compete for real-estate and in many cases, for power. In lieu of an imaging system, we propose a miniature star scanner that uses star presence detection to provide accurate attitude knowledge with significantly reduced SWaP. The star scanner technology has demonstrated success in previous space missions on larger platforms (e.g. SAS-A, ATS-C, OSO-7, and Galileo). It uses a detector that is positioned behind a narrow V-slit aperture to resolve star positions in the sensor-fixed frame. On nanosat spinners, or when integrated to a rotating mechanism, it can scan a virtual aperture covering a large portion of the celestial sphere for attitude determination. Here, we will also adapt the same scanner for orbit navigation. Our overall research objective is to develop an extremely small, very low power, and highly accurate attitude and orbit navigation sensor based on proven star scanner concept for smaller than 1U nanosats.

## Anticipated Benefits

N/A



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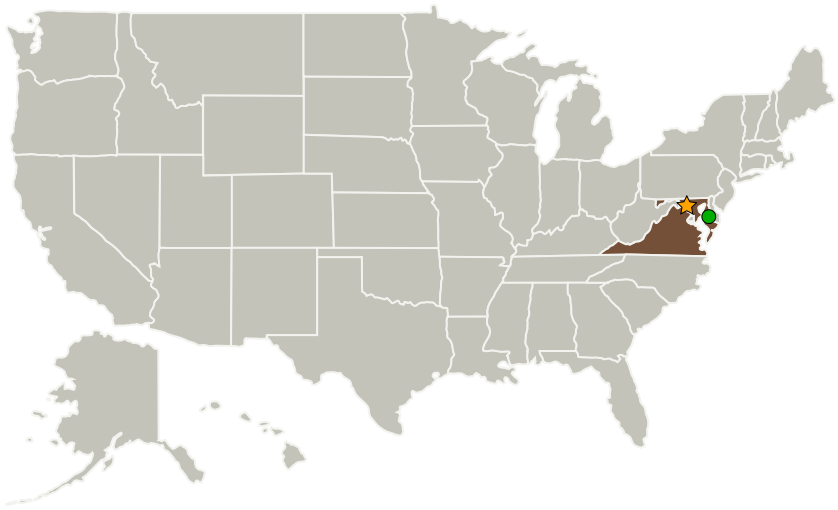
## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| ★Goddard Space Flight Center(GSFC) | Lead Organization | NASA Center | Greenbelt, Maryland |
| ●Wallops Flight Facility(WFF) | Supporting Organization | NASA Facility | Wallops Island, Virginia |

| Primary U.S. Work Locations | |
|---|---|
| Maryland | Virginia |

## Organizational Responsibility

**Responsible Mission Directorate:**

Mission Support Directorate (MSD)

**Lead Center / Facility:**

Goddard Space Flight Center (GSFC)

**Responsible Program:**

Center Independent Research & Development: GSFC IRAD

## Project Management

**Program Manager:**

Peter M Hughes

**Project Managers:**

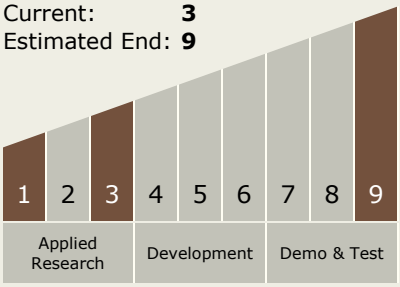
Dennis W Woodfork
Daniel A Mullinix

**Principal Investigator:**

Alvin G Yew

## Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **9**



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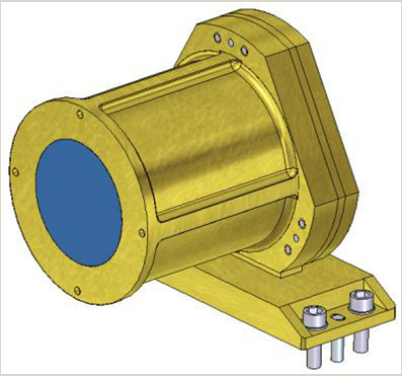
## Images



**Attitude and Orbit Navigation Scanner for sub-Nanosat Scale Platforms Project (SS Nano)**
Attitude and Orbit Navigation Scanner for sub-Nanosat Scale Platforms Project (SS Nano)
*(https://techport.nasa.gov/image/3998)*

## Links

GSC-17232-1
*(no url provided)*

## Project Website:

http://aetd.gsfc.nasa.gov/

## Technology Areas

**Primary:**

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.4 Attitude Estimation Technologies
    - TX17.4.3 Attitude Estimation Sensors